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INSECT ENEMIES OF THE REDWOOD*

by

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In 1881 Mr. Henry Edwards described a pitch worm as very destructive to Sequoia sempervirens. In 1899 the writer found two species of bark beetles living in the bark of recently felled trees. In 1900 the Division of Entomology obtained information from Mr. J. E. Norton, through a lumber firm in San Francisco, indicating that Redwood lumber was immune from attack by termites, or white ants; and this was verified by experiments conducted in the Philippine Islands by Mr. D. N. McChesney, as reported by Capt. George P. Ahern, Chief of the Philippine Forestry Bureau.

This embraces about all that has been published relating to Redwood insects.

These insects and their work may be described in more detail as follows:

THE SEQUOIA AEGERINIAN, OR REDWOOD PITCH WORM (Vespamima sequoiae Hy. Edw.)

This relative of the common peach-tree borer is described by Henry Edwards and other writers as very destructive to Redwood.

Mr. Beutemuller says:

"According to Hy. Edwards this species is devastating the pine forests in Mendocino County, California, and is particularly destructive to the Big Tree (Sequoia sempervirens), Pinus ponderosus, and Pinus lambertiana. The eggs are laid in the axils of the branches, the young caterpillar boring in a tortuous manner about its retreat, thus diverting the flow of sap and causing large resinous nodules to form at the place of its workings. These nodules gradually harden, the branch then dies, and the tree at last succumbs to its insignificant enemies. Hundreds of fine trees in the forests of the region are to be seen in various stages of decay. The moths make their appearance in June and July, during which period the eggs are deposited. The larvae begin to form their cocoons in December and January, being an evidence that the insect is double brooded. The larvae when fully grown line the channel in the resinous nodules with silk, forming a sort of cocoon, in which they transform to pupae."

This insect was observed by the writer in September, 1902, in the vicinity of Del Monte, Cal., where it occurred in the matured larval stage in large masses of pitch on the trunks of living Monterey Pine. According to information from Mr. Lee, the gardener in charge of the Del Monte grounds, it does considerable damage to the tree.

The work of probably the same insect was also observed in the same grounds on Lawson's Cypress, causing deformities on the main trunk and branches.

REMEDY

In comparatively small areas it would not be difficult to dig the worms out of the pitch with a knife during the fall and winter months. This would serve to greatly reduce their numbers and to prevent serious depredations in future. In the case of larger areas of forest trees there is, so far as known, no practical remedy.

* From U.S.D.A. Bureau of Forestry - Bulletin No. 38
"THE REDWOOD" Gifford Pinchot, Forester
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CEDAR-BARK-BEETLES

There is a certain class or genus of bark-boring beetles which, so far as has been determined in different countries, inhabits only the cedar and cedar-like trees. Owing to this habit they may properly be termed cedar bark beetles. They belong to the order Coleoptera, family Scolytidae, and genus Phloeosinus. Two species of this genus were found by the writer in living and partly living bark of recently felled Redwoods near Guerneville, Cal., in April, 1899.

THE REDWOOD BARK-BEETLE (Phloeosinus sequoiae Hopk. MSS.)

This is a common species, which heretofore has been confused with a much less common one described by Dr. LeConte under the name cristatus. It is a medium-sized, stout, black beetle, the male and female of which bore through the outer bark and excavate long, nearly straight burrows or galleries through the inner living or dying bark and surface of the wood. The eggs are closely placed along each side of the gallery in little notches excavated for the purpose. These soon hatch into minute white grubs, which immediately commence to feed upon the innter layers of bark and outer layers of wood. They continue to feed thus, extending meanwhile their food burrows, and increase in size until they attain their full growth as grubs (larvae). Then they enter the wood for a short distance and excavate a cavity or kind of cell, in which they change to the inactive or pupal stage. Here they remain until their legs and wings are fully developed, when, as fully matured adults, they bore their way out through the wood and bark, producing the shot-hole condition.

It is known that the Redwood bark-beetle flies early in April and attacks the living bark of recently-felled trees, but as yet we have no positive evidence that it attacks standing living trees. The fact, however, that a near relative, the Lawson's Cypress bark-beetle, will attack and kill trees, indicates that under specially favorable conditions this species may do likewise. Therefore any unhealthy condition of the young or old trees in which the leaves toward the top turn yellow and reddish brown should be examined for traces of the beetle's work in the bark and at the base of living twigs.

REMEDY

If it should be found that this beetle is attacking living trees, its known habit of infesting recently-felled trees suggests that it might easily be controlled by cutting and barking all infested trees between the 1st of September and the 1st of December, and by providing a few trap trees to attract those beetles that escape. This may be accomplished by felling a few trees in December. Then after the adults have entered the bark in the spring and the larvae (grubs) are about half-grown, or before they enter the surface of the wood, if the bark is stripped from all the infested parts of the trunk and larger branches, the broods will be destroyed. It will not be necessary to burn the bark thus removed, because the drying of the inner surf ace will kill the young stages, while some of the natural enemies of the beetle which would otherwise be destroyed by burning might survive to be of service in reducing the numbers of those which are not attracted to the trap trees or which breed in the standing timber. The tops and smaller branches, which can not conveniently be barked, should be burned, but they should first be left until the broods are nearly developed, in order that the parasites and other natural enemies may have time to develop and emerge to continue their good work. It would be best if this material were burned just before the beetles begin to emerge.

The life history of the Redwood bark-beetle has not been worked out, but the insect is probably double-brooded, the first brood emerging about the middle of summer and the other the following spring. If this true, it is of the greatest importance to protect, so far as possible, the natural enemies of the first brood, in order that they may continue their depredations on the second brood.

Evidence was found at Guerneville, in the vacant brood galleries in bark that had been infested the previous summer, that many of the broods had been destroyed by minute wasp-like parasites and predaceous enemies. It is probable that the natural enemies of other species of the same genus will attack it, especially those of the Lawson's Cypress bark-beetle.

LAWSON'S CYPRESS BARK-BEETLE (Phloeosinus cupressi Hopk. MSS)

This is the other species found by the writer in Redwood at Guerneville, Cal. It was also found, about the same time, in a recently dead Monterey Cypress in Golden Gate Park, and in a small, dying Japanese Cypress[a] in the University grounds at Berkeley.

The general character of this beetle and of its work is similar to that of the preceding beetle, except that it is a smaller, less shining insect, and that the larvae do not enter the surface of the wood to change to the adult, but undergo their transformation in their burrows in the innter bark.

The adult's habit of attacking and killing trees and of feeding on the bark of living twigs is a characteristic which has not been observed in any other species of the genus. Recently an article relating to this insect was published by Mr. Carroll Fowler,[b] under the above common name and the technical name Phloeosinus punctatus Lec.[c] Mr. Fowler's account of this beetle and its destructive work is as follows:

"During the past year our attention has been repeatedly brought to the sickly condition of many of our Lawson's Cypress trees. This is one of our common and most handsome ornamental trees, and therefore the way in which they are dying is a matter of no small concern to many parties.

"The first indication one has that the tree is diseased is in the unhealthy appearance of the upper leaves. These turn brown and die, and gradually those below take on a similar appearance, until they are all killed. If the trunk and branches are examined, it will be noticed that they are thickly punctured with small holes. Then if some of the bark is cut, it will be found to be dead in many places, especially near the top of the tree, not infrequently extending entirely across the branch. There will also be noticed small burrows just under the surface, and if it is in the winter there may usually be found at one end of each burrow a small white grub or dark brown beetle. This beetle is one of the engraver beetles, so called on account of the appearance of the system of burrows. The central tunnel is made in the sapwood by the mother beetle, which deposits eggs at frequent intervals. The larvae hatching from these eggs bore off at right angles. When the beetles are numerous the trees are frequently encircled, so that the food supply is cut off. The attack is usually begun at the top of tree, and extends downward from year to year.

"This family of beetles generally attacks trees that are not in a very healthy condition, although when they become very numerous they take to healthy trees. Such has proven to be the case with the Lawson Cypress beetle. Those trees which have suffered most severely from drought lately have been most severely injured by the pest, while those in the same locality which have been kept thrifty are in many instances almost free.

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a Identified by Professor Davy as Cryptomeria.
b Rept. Univ. of Cal. Agric. Exp. Sta., 1898-1901, Park I, pp. 80, 81.
c The writer has examined the specimens on which this identification was based, and finds that it is quite different from P. punctatus, a common enemy of the Giant and other Western cedars.

"After these borers have once gotten into a tree there is no way in which they can be killed without injury to the tree. Where the attack is severe the trees should be cut down and burned during the winter while the insects are in their burrows. They begin to eat their way out as early as March, although some appear much later; hence the destruction should be done earlier than this. Trees only slightly affected need not be destroyed, since by fertilization with Chile saltpeter and frequent watering they may be gotten into such a healthy condition as to withstand, and in a measure resist, attack. Professor Hilgard has by this means saved some of his trees, which were beginning to show marked signs of injury. Prompt measures should be taken against the insect, not only to save the trees attacked, but also to prevent the numbers from becoming so great as to cause them to spread to healthy trees."

Dr. Hilgard informs the writer that his experiments with Chile saltpeter were very successful indeed, and that he believes little harm would result from the attack of this insect if the trees were kept in a healthy, vigorous condition.

Early in September of this year the writer had an opportunity to make some additional observations on the habits of this beetle at Del Monte and in the famous Monterey Cypress grove at Cypress Point, Cal. These observations indicate quite clearly that the Monterey Cypress is the original food plant, and that the common use of this tree for hedges and ornament in private grounds and parks throughout western California has enabled the beetle to extend its range from its original restricted home, and thus to acquire the habit of attacking other species of Cypress and the Redwood. This change of habit and extended range of distribution, as has been demonstrated by many of our worst insect pests which have come from other countries and other sections of our own country, involves variation in normal habit, and even in structure, which renders a species that is comparatively harmless in its original home most destructive under the influence of new environments.

An examination of the Cypress grove showed no sign that this beetle had attacked standing trees, although it was found to be exceedingly common in the bark of broken branches and storm-felled trees. The natural enemies of the broods occurred in great numbers, and up to the date of writing the number of adult parasites which have emerged from sections of branches placed in breeding jars has been exceedingly large.

An examination of Lawson's Cypress, which had been transplanted in the park at Del Monte, showed that the Lawson's Cypress bark-beetle has the common habit of boring into the living bark at the base of perfectly healthy twigs. It was also found that this injury would often result in the death of the lateral and deformity of the central twigs, while in many cases the wound would be covered with gum and heal without any serious harm. This is conclusive evidence that the beetle attacks healthy plant tissue of the Lawson's Cypress. This was further verified by specimens of wood from a Lawson's Cypress said to have been killed by the beetle, which were kindly submitted to the writer by Professor Woodworth, entomologist of the California experimental station at Berkeley. An examination of this specimen showed in the healed-over wounds made by the beetles that at least two successive annual attacks on the living bark had been made before the tree died. Nevertheless, the annual rings of wood showed nearly a normal growth and indicated an otherwise healty condition up to the year in which the tree died. It would therefore appear that while the insect breeds normally only in the felled or otherwise injured trees, it is capable of attacking healthy trees and of causing the death of transplanted Monterey, Lawson's, and other species of Cypress. The fact that it has been found in Redwood renders it an enemy of especial interest in this connection, and one which should be carefully watched.

Recent observations by the writer near Mill Valley, California, and along the railroad leading up the western slope of Tamalpais, of an unhealthy condition of the tops of second-growth Redwood, suggest that this heretofore unnoticed trouble may be due to the work of the Lawson's Cypress, or the Redwood, Bark-beetle. It is reported that much of the Lawson's Cypress in the country mentioned has recently died. If this has been caused by the Lawson's Cypress bark-beetle, as it probably has, the same insect may be to blame for the diseased condition of the Redwood.

REMEDY

The maintenance of a healthy, vigorous growth by the application of Chile saltpeter or other fertilizers which may hereafter be found especially useful for this purpose, in addition to irrigation during severe drought, as suggested by Dr. Hilgard, is undoubtedly a most excellent provision against attack, and wherever practicable should be adopted. Otherwise, where forests of Redwood or other trees are infested or threatened by an invasion of this enemy, the recommendations for cutting and barking infested trees and for providing trap trees for the control of the Redwood bark-beetle should be adopted.

PARASITES

The parasite reared from Monterey Cypress bark infested by this beetle was submitted to Mr. William H. Ashmead, the recognized authority on this class of insects, who found that it is a Cecidostiba sp. The abundance of this parasite, in what is evidently the normal home of the beetle, suggests that this species may very profitabley be introduced into localities where the beetle is carrying on its destructive work on the same or other trees. This could easily be accomplished if medium-sized branches were cut from trees in the original grove during February, left there until thoroughly infested with broods of the beetles and their parasites, then, just before time for the parasites to emerge, cut into sections about 1 foot long and taken without delay to the desired localities and there placed among the tops of the felled trees. The parasites would then emerge and readily find their victims. Any efforts of this kind, however, should be made by an entomologist, or under his supervision.

THE MONTEREY CYPRESS BARK-BEETLE (Phloeosinus cristatus Lec.)

This is another Cedar bark-beetle which is closely allied to the preceding, and is the true cristatus, with which several other species have heretofore been confused.

In February, 1893, specimens of this insect and its work were sent to the Division of Entomology by Mr. J. Dickee, Riverside, Cal., with a statement that it was doing great damage to Cypress hedges in Contra Costa County, Cal. Nothing further is known of its habits, but it is possible that it may also attack the Redwood.

The other species of insects found by the writer in Guerneville, Cal., in Redwood, may be briefly mentioned as follows:

Phymatodes decussatus Lec. This long-horn (Cerambycid) was reared from a section of a small dead tree, and the larva of probably the same insect was found in the bark of a dying tree.

Callidium janthinum Lec. A dead adult of this well-known enemy of Cedar was found on the bark of a log, where it had evidently bred.

IMMUNITY OF REDWOOD FROM ATTACK BY TERMITES OR WHITE ANTS

Probably the first officially published record of the relation of Redwood to the wood-destroying termites of tropical regions was that which appeared in Bulletin No. 30, new serious, Division of Entomology, U. S. Department of Agriculture (1901), p. 95. This reference is quoted as follows:

"December 13, 1900, we received a communication through a firm of lumber merchants of San Francisco, Cal., which appears to indicate that the California Redwood lumber is immune to the attack of white ants or termites. Through the firm in question we received a letter from Mr. J. E. Norton, dated December 4, relating to the resistance of this wood to the so-called Manila white ant of Annia. His letter is in substance as follows:

"'In the latter part of 1898 I secured from a transport a piece of Redwood Lumber in a yard at Manila. The spot was damp, and various pieces of timber all around showed evidence of the existence of the ant in abundance. This piece lay undisturbed for a period of five or six months, and when examined was found as sound as when put there, not having been attacked by any insects. The Chinaman, owner of the lumber yard, was still doubtful and undertook to get it eaten by putting it in different places under different conditions, such as on top of pieces already inhabited, between boards, and underneath piles, and finally, after three months, put the sample on exhibition in his office with the following placard: 'Madera Colorado de California, no se comen Annai.'

"'The quartermaster's lumber yard had piled for some four or five months a quantity of Redwood, which upon my departure in October was still free from ants.

"'John MacLeod, of Manila, has a room in one of his houses finished in Redwood, constructed over fifteen years ago, and to this day three-fourths of the original amount remains still in good condition, one-fourth having been worn out and replaced by other lumber."

Reference is made in Bulletin No. 33 of the Bureau of Forestry (p.20) to certain experiments conducted in Manila, P.I., by Mr. D. N. McChesney, as reported by Capt. George P. Ahern, Chief of the Philippine Forestry Bureau, in which it would appear that Redwood, Incense Cedar, and Western Hemlock were not attacked, while Douglas Spruce, Bull Pine, and Engelmann Spruce were seriously injured.

The ready is referred to Circular No. 50, second series, Division of Entomology, U. S. Department of Agriculture, by C. L. Marlatt, for a general description of white ants, their habits and work.